Geophysical Terranes of the Great Basin and Parts of Surrounding Provinces

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INTRODUCTION

This study of geophysical terranes within and surrounding the Great Basin of the western United States (fig. 1A) integrates geophysical and geologic data to provide new insights on basement composition and structure at local, intermediate, and regional scales. Potential field (gravity and magnetic) studies are particularly useful to define the location, depth, and extent of buried basement sources and fundamental structural or compositional boundaries. They especially serve in imaging the subsurface in areas of extensive Cenozoic cover or where surface outcrops may be detached from the deeper crust. Identifying buried compositional or structural boundaries has applications, for example, in tectonic and earthquake hazard studies as they may reflect unmapped or buried faults. In many places, such features act as guides or barriers to fluid or magma flow or form favorable environments for mineralization and are therefore important to mineral, groundwater, and geothermal studies. This work serves in assessing the potential for undiscovered mineral deposits and provides important long-term land-use planning information. The primary component of this report is a set of geophysical maps with anomalies that are labeled and keyed to tables containing information on the anomaly and its source. Maps and data tables are provided in a variety of formats (tab delimited text, Microsoft Excel, PDF, and ArcGIS) for readers to review and download. The PDF formatted product allows the user to easily move between features on the maps and their entries in the tables, and vice-versa. Our goal in highlighting these anomalies is to stimulate thought and research about crustal features of the Great Basin. While we do not offer comprehensive interpretation of every gravity and magnetic feature in the Great Basin, we hope this product will serve as a useful spatial catalog of those features.

Physiography

The Great Basin is a broad hydrologically closed region spanning much of the western United States (fig. 1A). It forms part of the Basin and Range Province (Figure 1B), which is characterized by late Cenozoic regional extension ranging from Mexico nearly to Canada and California to Texas. This extension has been accompanied by normal and detatchment faulting, crustal block uplift, downdrop, rotations and tilting, crustal thinning and ductile flow, and widespread magmatism. Crustal blocks expose a range of variably deformed pre-Cenozoic rocks as well as early and middle Cenozoic volcanic rocks.

The study area (fig. 1A) includes the Great Basin and parts of ten adjacent physiographic provinces (Cascade Mtns, Columbia Plateaus, Snake River Plain, Northern Rocky Mtns, Sierra Nevada, Great Valley, Coast Ranges, Mojave Desert, Colorado Plateaus, and Middle Rocky Mtns). The Great Basin is sharply defined on its northern, western and eastern margins where it is bound by the Snake River Plain, Sierra Nevada, and Colorado Plateaus, respectively. Northwestern, northeastern and southern boundaries, however, are less well defined. Definitions of the Great Basin and its surrounding provinces used in this report largely follow those of Fenneman and Johnson (1946).

Potential Field Geophysics

Several excellent reviews of magnetic methods have been published by Grant (1985a,b), Reford (1980), Hinze and Zietz (1985), Blakely (1995), and Gunn and Dentith (1997). Similarly, Simpson and others (1986), Simpson and Jachens (1989), Jachens and others (1989), and Blakely (1995) provide informative reviews of gravity methods. These geophysical techniques, which allow imaging of subsurface structure, are particularly important in the Great Basin where more than 75% of the surface is covered by Cenozoic deposits. Gravity and magnetic anomalies occur due to lateral contrasts in rock density and magnetic properties (induced and remanent magnetizations), respectively. Rock-property contrasts may occur within a rock unit, such as resulting from gradual lateral facies changes or heterogeneous alteration, or at geologic structures such as faults, folds, or contacts. The geometry and depth to sources, the character of the geomagnetic field, and the rock properties of sources all determine the character of the associated potential field anomalies. Despite the complexity of potential fields and their sources, gravity and magnetic data can be used to resolve the geometry and origin of sources, particularly when combined with other geologic constraints such as the regional tectonic models, surface geology, and seismic data.

GRAVITY DATA

Gravity data were compiled from a variety of sources reduced and gridded (Hildenbrand and others, 2000) to produce the various gravity and derivative maps shown in this report. Gravity maps, derived from these data, reflect anomalies that may arise from contrasts in density due to contacts between different rock units, partial melting, or phase transitions. Generally, long-wavelength anomalies with smooth gradients originate from sources at depths greater than sources of short-wavelength anomalies that display steep gradients. While short-wavelength anomalies must arise from sources at shallow depths, long-wavelength anomalies, could arise from shallow, thin sources that have gently sloping sides.

In order to produce a gravity map reflecting lateral variations in density in the crust, raw gravity measurements were reduced using standard gravity reduction methods (Dobrin and Savit, 1988; Blakely, 1995). These reductions remove the effects of elevation, topography, total mass, rotation, and ellipsoidal shape of the Earth and yield the complete Bouguer gravity anomaly (CBA). Although the CBA reveals lateral density variations at short wavelength scales, it does an inferior job isolating longer wavelength features since these are often masked by broad anomalies due to deep crustal roots that isostatically compensate topographic loads. The isostatic correction attempts to remove effects of compensating masses.

Despite its name, an isostatic anomaly does not necessarily reflect the state of isostatic equilibrium. In this study, we are most interested in those cases where anomalies arise from density inhomogeneities in the crust. Nonetheless, it should be noted that an isosatic anomaly may reflect areas out of isostatic balance, either dynamically or by means of elastic support. For example, because the isostatic correction ignores effects of lithospheric strength it may not acurately account for regional fields associated with topographic loads. Thus, in areas where the lithoshere is exceptionally strong, topographic loads can be supported regionally, and compensation distributed over the area of elastic flexure rather than being locally compensated.

A general correlation between topography and the regional bouguer gravity field indicates that across the Great Basin the crust is in isostatic equilibrium. A common misconception is that the depth of compensation corresponds to the Moho. Because Bouguer gravity does not correlate to crustal thickness (Eaton and others, 1978) and gravity effects due to variations in the crustal thickness versus lithospheric thickness differ by an order of magnitude (i.e., asthenoshere/lithosphere density contrast is ~0.08 g/cc and between crust and lithosphere it is ~0.4 g/cc), compensation likely occurs at mid-crustal depths. In the Great Basin, where heat flow is high and extension is large, isostatic compensation is probably achieved over relatively short lateral distances (e.g. 150 km), and within relatively shallow crustal depths perhaps within the upper 20 km (Eaton and others, 1978).

Although the close correspondence of topography and Bouguer gravity suggests compensation is achieved largely by an Airy-Heiskanen mechanism, some regions, such as the Rocky Mountains (Eaton and others, 1978, Woollard, 1972), are best fit with a Pratt model that achieves compensation through lateral density variations. This is indicated by crustal density variations inferred from seismic compressional wave velocity data. It has been suggested that isostatic equilibrium and extension in the Great Basin are likely accommodated by shallow crustal intrusion or ductile flow, especially in areas such as core complexes where the crust has undergone significant stretching and thinning (Thompson and McCarthy, 1990).

MAGNETIC DATA

Magnetic data were derived from a compilation of statewide compilations (Hildenbrand and others, 2000). Surveys have all been continued to a common reference level of 0.305 km above ground surface, gridded, and filtered to produce the magnetic maps shown in this report. Variations in the magnetic field arise from contrasts in the magnetic properties of rocks. These contrasts can be due to a number of different sources including crustal structures, metamorphism and alteration, variations in remanent magnetization, and variations in the concentration and type of magnetic minerals.

Generally, the most significant contributions to crustal anomalies arise from magnetite, one of the most common, strongly magnetic minerals in the crust. Furthermore, because the magnetic susceptibility of magnetite dramatically drops at temperatures above the Curie point (580° for pure magnetite), the portion of crust most responsible for variations in the magnetic field is that which lies above the Curie isotherm. This probably coincides roughly with the Moho, though in areas of high heat flow, like the Great Basin, it may occur at significantly shallower depths.

Although the magnetic field strength depends on both induced and remanent crustal magnetization, it is often assumed that the remanent component is negligible. This is because remanence is often low enough to ignore or because remanent components are often aligned close to the induced field component. In general, this is supported by the character of many magnetic anomalies. For example, in the northern hemisphere, anomalies often have relatively weak minima that lie to the north of their maxima counterparts (note that magnetic sources generally display bipolar anomalies). An important effect on the character of geophysical anomalies is the depth to the source. The shallower the depth to a body, the higher the amplitude, the shorter the wavelength, and the sharper the gradients of its anomaly. Generally, magnetic highs arise from mafic igneous and crystalline basement rocks, whereas lows arise from felsic igneous, sedimentary, or altered basement rocks. Igneous outcrops not associated with high-amplitude magnetic anomalies might be thin or contain low concentrations of primary magnetic minerals, or have lost them due to alteration.

Aeromagnetic anomalies in most of the Great Basin have been found to arise from Precambrian metamorphic, Mesozoic granitic and gabbroic, Tertiary calc-alkaline volcanic and intrusive, and Tertiary basaltic rocks (Blakely, 1988). Much of the Precambrian basement in the Great Basin is weakly magnetic, in contrast to the magnetic basement of the Colorado Plateaus (Mabey and others, 1978).

FILTERING AND DERIVATIVE METHODS

Basement Gravity

An iterative gravity inversion method (Jachens and Moring, 1990), used to determine the depth to pre-Cenozoic basement and the thickness of Cenozoic basin deposits, was applied to the Great Basin to obtain a basement gravity map (Figure 2), a by-product of the depth-to-basement process. Basement gravity, which is the isostatic gravity with the effects of Cenozoic basins removed, reflects lateral density variations in pre-Cenozoic basement rocks and is particularly useful for defining pre-Cenozoic structures and crustal geophysical terranes.

Isostatic gravity anomalies were used during this inversion process because they enhance or reflect shallow- to mid-crustal sources within the Earth by removing long-wavelength variations in the gravity field inversely related to regional topography (Simpson and others, 1986). The Basement gravity inversion process depends on their being a significant contrast in density between the usually dense basement rocks and any overlying Cenozoic deposits. While this is true for much of the Great Basin, Cenozoic mafic volcanic rocks can have densities similar to those of their underlying basement rocks. This is a problem, particularly in the northwestern-most part of the Great Basin that is blanketed by middle Miocene mafic lava flows. As a result, the inversion process was not applied in areas where the thickness of overlying volcanic rocks could not be determined. The boundary within which the depth-to-basement calculation was applied is shown in Figure 2. Outside this boundary, we show isostatic gravity values.

The depth-to-basement method separates the gravity field into two components: the gravity field caused by pre-Cenozoic basement and the gravity field caused by overlying younger basin deposits. An initial basement gravity field is determined by using only stations located on pre-Cenozoic basement outcrops. The initial basement gravity field is approximate because stations located on basement are influenced by the gravity effect of low-density deposits in nearby basins, especially for those stations near the edge of the basins. The difference between the isostatic gravity and basement gravity fields provides the first estimate of the basin gravity field, which is inverted to provide the first estimate of the basin shape. The gravitational effect of the basins is subtracted from each station located on basement and a new and improved basement gravity field is determined. This process is repeated until successive iterations converge. Inversion of the final basin gravity field yields the final estimate of the depth to pre-Cenozoic basement. The density of basement rocks is allowed to vary horizontally, whereas the density of basin-filling deposits increases with depth according to a density-depth relationship defined by Jachens and Moring (1990).

A number of limitations are inherent in this method, including uncertainties that relate to: the gravity data coverage, especially for stations on basement outcrops; the density-depth function; accuracy and scale of the geologic mapping; simplifying assumptions regarding concealed geology; and the distribution of basement outcrops. A more detailed discussion of the limitations and accuracy of the method were provided by Jachens and Moring (1990).

Magnetic Potential (pseudogravity)

Crustal magnetism differs from and is more complex than gravity, which varies due simply to the crustal density distribution. Magnetism varies because of differences in both the concentration and type of magnetic minerals within the crust (analogous to the relation between density and gravity), and crustal remanent magnetization. Furthermore, because crustal magnetization is seldom vertical, except at the magnetic poles, anomalies are asymmetric and not centered over their sources. In addition, unlike gravity, crustal remanent magnetism has a depth limit set by the Curie temperature isotherm, the temperature above which remanent magnetization does not exist. Magnetic data also tend to highlight shallower features than gravity, because magnetic field strength attenuates more significantly with distance to the source than does gravity.

Because of this complexity of magnetic anomalies they are typically more difficult to interpret. The pseudogravity or magnetic potential transformation (Baranov, 1957; Blakely, 1995) removes asymmetry of anomalies, by centering them over their sources, and allows for a more accurate estimate of the extent of source bodies. In addition, it helps highlight regional magnetic features masked by high-frequency anomalies.

Because the magnetic and gravity potentials are related by a directional derivative, thus the total magnetic field can be transformed into an equivalent gravity field. Magnetic potential, or pseudogravity, maps are produced by the transformation of the magnetic field into the equivalent gravity field assuming a density distribution equal to the magnetization distribution (Baranov, 1957). The ratio between magnetization and density is held constant and remanent magnetization is assumed to be either negligible or in the same direction as the Earth's magnetic field. This process amplifies long wavelengths (deeper sources) at the expense of short wavelengths (shallow sources). In addition, because gravity anomalies have their steepest gradients approximately over the edges of their causative sources, especially for shallow sources, the magnetic potential map can be used to approximate the edges of magnetic sources (Blakely, 1995).

Maximum Horizontal Gradients

To better define the edges of geophysical sources and to help derive geophysical lineaments and terranes, the amplitudes of the maximum horizontal gradients (AMHG) of both gravity and magnetic data were computer generated. A technique described by Blakely and Simpson (1986) was used to calculate the AMHG. Because the AMHG tend to lie over the edges of bodies with near vertical boundaries (Cordell and McCafferty, 1989; Grauch and Cordell, 1987), they are useful at estimating the extent of buried sources. AMHG were derived for both previously described basement gravity and magnetic potential maps. Because these maxima reflect abrupt lateral changes in the density or magnetization of the underlying rocks, they were used to aid in defining the boundaries of geophysical terranes shown in Figures 2 and 3.

POTENTIAL FIELD MAPS

Gravity and magnetic lineations (shown in figs. 2 and 3, respectively) were derived with the aid of the AMHG method described above. Geophysical terranes are based in part on the AMHG-derived boundaries and on geophysical fabric. Areas, for example, that display a consistent trend or wavelength of anomalies, in contrast to their surroundings, were defined as distinct geophysical terranes that may represented discrete crustal blocks having similar physical properties or sources. Gravity and magnetic terrane maps (figs. 2 and 3) were created by visual inspection of gravity, magnetic, and derivative geophysical maps, and by drawing polygons around similar geophysical areas using derived lineaments as a guide to locating terrane boundaries. In addition to geophysical terranes, we have also included a number of lineations. A few of these are defined as geophysical features listed in table 1, while others occur on figures 2 and 3 simply as unlabeled features that are intended to highlight the geophysical fabric.

GEOPHYSICAL TERRANE TABLE

The geophysical terrane table (table 1) lists geophysical terranes that occur on the gravity and magnetic terrane maps (figs. 2 and 3). The table is organized to allow the user to identify features in the table that occur on the maps, and to move between maps and table. Terrane names contain (from left to right): a two letter (uppercase) code identifying the state in which they mostly occur, a single letter (lowercase) code identifying whether the feature is a gravity (g) or magnetic (m) terrane, and a two digit number indicating the feature number. Geologic and geophysical references provided in the table point the user to an example of work pertaining to some part of the anomaly or to its presumed source rock, and should not be considered a complete list of pertinent or historical citations. We refer the reader to references contained within the cited publications for further background. Several of the table columns are specifically defined such that they may be used as search terms or as tools for sorting the table based on the terrane characteristics (These include: Generalized Source Rock, Province, Tectonic Setting, and Scale). A brief discussion of these terms is provided below. These search fields are inherently simplified and may not adequately explain the character, especially of diverse terranes.

Generalized Source Rock

Five primary rock categories (sedimentary, volcanic, intrusive, metamorphic, and basement) are used in conjunction with five secondary rock categories (silicic, mafic, ultramafic, carbonate, and siliceous) to provide thirteen categories (table 3) to describe the generalized source rock. Note that in some cases, the choice between terms is arbitrary. For example, basement and metamorphic rock categories overlap, and in many cases are interchangable. Here, 'Metamorphic' is generally used in the Coast Ranges and Klamath Mountains, and 'Basement' in the Great Basin and Colorado Plateaus. In areas where several different source rocks may be present, multiple rock type terms have been used. 'Basement' is generally used throughout this report to refer loosely to dense, crystalline, and usually Precambrian rocks. This is in contrast to its use in the term 'basement gravity' (e.g., fig. 2), which considers basement as pre-Cenozoic rocks assumed to be dense, crystalline rocks of many types. Note that in places where source rocks are entirely covered, the inferred source rock type is generally inferred from the gravity and magnetic character of the terrane, and may not be unique. For example, a gravity and magnetic low that could be inferred as due to silicic basement might instead be due to depressed basement that has no lateral variation in basement composition.

Table 3. Generalized source rock categories

Primary	Secondary	Usage
sedimentary	carbonate	Generally used to refer to dense sedimentary rocks (e.g. limestone, dolomite).
	siliceous	Generally used to refer to non-carbonate sedimentary rocks (e.g. sandstone, siltstone, argillites, cherts).
volcanic	silicic	Generally used for non-magnetic volcanic rocks. An exception to this is in areas of silicic tuff. Generally includes intermediate composition rocks (e.g. andesites).
	mafic	Generally used for magnetic volcanic rocks.
intrusive	silicic	Generally used for low density or non-magnetic intrusive rocks. Generally includes intermediate composition rocks (e.g. dacites).
	mafic	Generally used for dense or magnetic intrusive rocks. Note that some granitic rocks can be dense.
	ultramafic	Generally used for dense or magnetic intrusive rocks.
metamorphic	silicic	Generally used for low density or non-magnetic (e.g. quartzose) metamorphic rocks.
	mafic	Generally used for dense and magnetic metamorphic rocks.
	ultramafic	Generally used for dense and magnetic metamorphic rocks.
basement	silicic	Generally used for relatively low density or non-magnetic basement rocks.

	mafic	Generally used for very dense and magnetic basement rocks.
	carbonate	Generally used for dense and non-magnetic basement rocks.

Tectonic Setting

The ‘Tectonic Setting’ category describes the tectonic setting associated with the development of the geophysical feature. In cases where a terrane formed from several geologic events or during multiple stages, or straddled different tectonic settings, multiple categories of ‘Tectonic Setting’ were used. As a result, both ancient and recent settings may be listed. Nonetheless, the most representative setting controlling the character of the feature is given (e.g., the ‘Tectonic Setting’ of Salinian granites in the Coast Ranges is given as both ‘Batholith’ and ‘Transcurrent’ because the shape of the block subsequent to the rocks having formed as a batholith was modified by transcurent strike-slip motion). In cases where multiple terms are given, the setting considered primarily responsible for the feature is listed first. When there is doubt as to the origin of the source, the present tectonic setting is given (e.g. ‘Extension” applies to sources within the Great Basin with no known tectonic origin). Table 4 lists ‘Tectonic Setting’ categories that include eleven terms (extension, transcurrent, compression, stable crust, subduction, accretion, uplift, depression, hotspot, batholith, continental margin). The use of ‘Subduction’ to describe the tectonic setting of terranes within the Great Basin applies to Mesozoic intrusive rocks mainly in the western Great Basin (Walker Lane Belt) and Oligocene to middle Miocene volcanism that occurred throughout the Great Basin due to shallowing and subsequent steepening of the subducting Farallon slab.

Table 4: Tectonic setting categories

Tectonic setting	Usage
extension	Generally applies to entire Great Basin with Basin and Range type extension and to even greater extended terranes. Also used to describe back-arc spreading as seen in the Oregon highlands.

transcurrent	Refers to areas subjected to significant strike-slip deformation. Generally applied to right-lateral displacements in Coast Ranges and the Walker Lane.
compression	Used in the region east of the Idaho Batholith and north of the Snake River Plain -- an area in the Rocky Mountains Foreland Thrust Belt.
stable crust	Largely applies to the Colorado Plateaus region and refers to areas of weakly deformed flay-lying Mesozoic and Paleozoic rocks.
subduction	Applies to major batholiths and to extensive magmatism in the Great Basin thought to relate to shallowing of the subducting Farallon Plate in the later part of the Cenozoic.
accretion	Used extensively in California in the Coast Ranges, Klamath Mountains, and extending to the western Sierra Nevada. These areas are often also associated with transcurrent tectonic setting.
uplift	Used for blocks of basement uplifted on high-angle faults or on flextures. Areas include core complexes and the Colorado Plateaus.
depression	Used largely for isolated basins in the California Coast Ranges. Also associated with areas of pull-apart tectonics. Can also apply to depressed basement.
hotspot	Used to refer to magmatism and fracturing associated with the ancestral Yellowstone hotspot.
batholith	Used to refer to large granitoid intrusions associated with the Sierra Nevada, Salinian Block, and Idaho Batholiths and to fragments of these such as may occur eastern California and west-central Nevada.
continental margin	Refers to Paleozoic and Mesozoic continental margin in the Great Basin. Defined esentially by the edge of the continental shelf.

Provinces

Geophysical terranes within twelve physiographic provinces, that include the Great Basin and parts of its surrounding provinces (Cascade Mtns., Coast Ranges, Colorado Plateaus, Columbia Plateaus, Great Valley, Klamath Mtns., Middle Rocky Mtns., Mojave Desert, Northern Rocky Mtns., Sierra Nevada, Snake River Plain) are described in this report (figs. 2 and 3, table 1). Figure 1 shows the extent of these provinces (note that the province boundaries used here largely follow those of Fenneman and Johnson (1946), and table 2 gives their physiographic, geologic and geophysical descriptions.

In places, province boundaries are poorly defined, for example, at the boundary between the Great Basin and Columbia Plateaus Provinces. This boundary, which is not well expressed physiographically, represents one of the few differences between the province map used here and that of others (e.g. Fenneman and Johnson, 1946). Terms used under the ‘Generalized Tectonic Setting’ column refer to the same terms used in Table 4 and described above.

Scale of Geophysical Features

At the broadest scales, geophysical terranes can reflect major deep-seated crustal discontinuities such as transform, accommodation, or shear zones, ancient continental margins, failed rifts, accretionary belts, or magmatic arcs. At local scales, they can reflect, for example, individual faults or intrusive bodies. Below is a description and definition of terrane scales that appear in table 1.

Regional-scale Geophysical Provinces

Regional scale terranes are considered to constitute very large regions, extending from hundreds to thousands of kilometers, that may consist of an assemblage of smaller-scale features that share a common character in contrast to surrounding regions (e.g. the terrane may define a zone of consistent geophysical fabric). A regional-scale feature may reflect a region of common tectonic or magmatic history and it may be bound by deep crustal to subcrustal faults. Some examples include volcanic plateaus, broad shear zones, and broad and coherent crustal blocks bound by deep crustal faults. Identification of regional-scale features is aided by standard and long-wavelength geophysical maps, fabric analysis, contrasts of dominant frequencies, and contrasts in mean gravity and magnetic values.

A description of the regional geophysical expression of the Great Basin and each of its surrounding provinces is given in table 2. The broadest expression in regional gravity and magnetic maps of the study area are reflected in figure 4, which show outlines that roughly mimic the shape and extent of the entire Great Basin. These largest of terranes appear in table 1 as the first two entries.

The Great Basin boundary has relatively sharply defined geophysical boundaries, though these, in places, crosscut the physiographically and geologically defined boundaries of the region. To the north it contrasts with the high basement gravity and magnetic character of the Snake River Plain, although the gravity high over the northern Great Basin merges with that of the Snake River Plain. To the west, the high frequency magnetic and moderate gravity highs of the western

Great Basin abut the prominent northwest-trending magnetic high and gravity low of the eastern Sierra Nevada Province. At its east edge, the Great Basin is rimmed by the Colorado Plateaus. Though its contact is not particularly clear in the basement gravity, the generally low magnetic fields over the Great Basin contrast sharply with the high magnetic terrain of the Colorado Plateaus. More ambiguous occur to the northeast, northwest, and south where the Great Basin meets with Middle Rocky Mountains, Columbia Plateaus, and Mojave Desert Provinces, respectively.

Intermediate-Scale Geophysical Features

Intermediate-scale terranes constitute large coherent anomalies (e.g., crustal rifts or sutures, structural basins or ranges, or batholiths) that extend on the order of tens to hundreds of kilometers. Identification of these regional-scale features is aided by standard geophysical maps, long- and short-wavelength maps, and AMHG maps.

Local-Scale Geophysical Features

Local-scale features (reflecting, for example, individual plutons, faults, or calderas) reflect anomalies arising from discrete source bodies that reside in the shallow to mid-crust, and extend over several tens of kilometers. Identification of local-scale features is aided by standard geophysical, long- and short-wavelength, and AMHG maps. Although a few local-scale anomalies are described in this report, a detailed assessment of local-scale anomalies is beyond the scope of this study.

DISCUSSION

This work provides an introduction to geophysical terranes of the Great Basin and surrounding regions, with interpretations of their underlying causes. The aim of this work is to relate geophysical terranes to their geologic domain counterparts, to resolve the nature of transitions between terranes, and to understand their origin, and their relation to basement structures and composition.

The study spans local-scale (e.g., individual plutons, faults, or calderas), anomalies arising from discrete source bodies that reside in the shallow to mid-crust, and extend over an order of several tens of kilometers to regional-scale features (very large regions, extending from hundreds to thousands of kilometers). Assessment of geophysical terranes was aided by a variety of filtering and derivative methods, and took into account frequency, amplitude, fabric, and gradients of terranes anomalies.

Geophysical maps and data tables of this report are provided in a variety of formats (tab delimited text, Microsoft Excel, Microsoft Word, PDF, and ArcGIS) for readers to review and download. The PDF formatted product contains useful links that allow the user to easily move between features on the maps and their entries in the tables.

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TABLES

Table 1. Geophysical features of the Great Basin and parts of surrounding provinces. Terranes appear in the table sorted in the order of: state, gravity number, and magnetic number. Refer to gravity and magnetic terrane maps (figs. 2 and 3, respectively). The table gives (from left to right): Scale of anomaly (R=Regional, I=Intermediate, L=Local); Terrane ID (containing from left to right: 2 digits for the state, 1 'm' or 'g' for magnetic or gravity anomaly, respectively; two digits for terrane number); Terrane definition (describes the geophysical characteristics that define the feature), Anomaly type (H=high, L=low, or B=both high and low); Geologic Province (describes the geology associated with the geophysical terrane); Inferred source of anomaly; Generalized source rock (see Table 3 for description of terms); Tectonic setting (see table 4 for description of terms); Province (gives the associated physiographic province, see table 2); References. Abbreviations include: BR, Basin and Range; CP, Colorado Plateau; CRP, Columbia River Plateaus; Cz, Cenozoic; GB, Great Basin; Mz, Mesozoic; NNR, Northern Nevada Rift; pC, Precambrian; Pz, Paleozoic; SRP, Snake River Plain. For further details, see text.

Table 2. Physiographic provinces and their geologic and geophysical character. Physiographic province boundaries and descriptions are modified from Fenneman and Johnson (1946).

FIGURES

Figure 1. A) Index map of the Great Basin showing digital shaded relief and outlines of the Great Basin and surrounding physiographic provinces. Physiographic province boundaries are modified from Fenneman and Johnson (1946); B) The Basin and Range extensional province that includes the Great Basin.

Figure 2. Basement gravity terrane map of the study area. Blue lines are edges of gravity sources determined by the maximum horizontal gravity method; each feature is uniquely labeled and described in Table 1. Yellow lines are linear gravity features, labeled uniquely and described in Table 1; red lines are unlabeled, undescribed, linear gravity features. White line

shows boundary within which basement calculation was performed. Isostatic gravity is shown outside this boundary.

Figure 3. Magnetic potential terrane map of the study area. Blue lines are edges of magnetic sources determined by the maximum horizontal gravity method; each feature is uniquely labeled and described in Table 1. Yellow lines are linear magnetic features, labeled uniquely and described in Table 1; red lines are unlabeled, undescribed, linear magnetic features.

Figure 4. Regional isostatic gravity and pseudogravity field maps of the Great Basin and surrounding area. The white outline represents the Great Basin boundary in each map. The black outlines represent the regional gravity terrane and regional pseudogravity terrane described in Table 1 as G1 and M1, respectively.

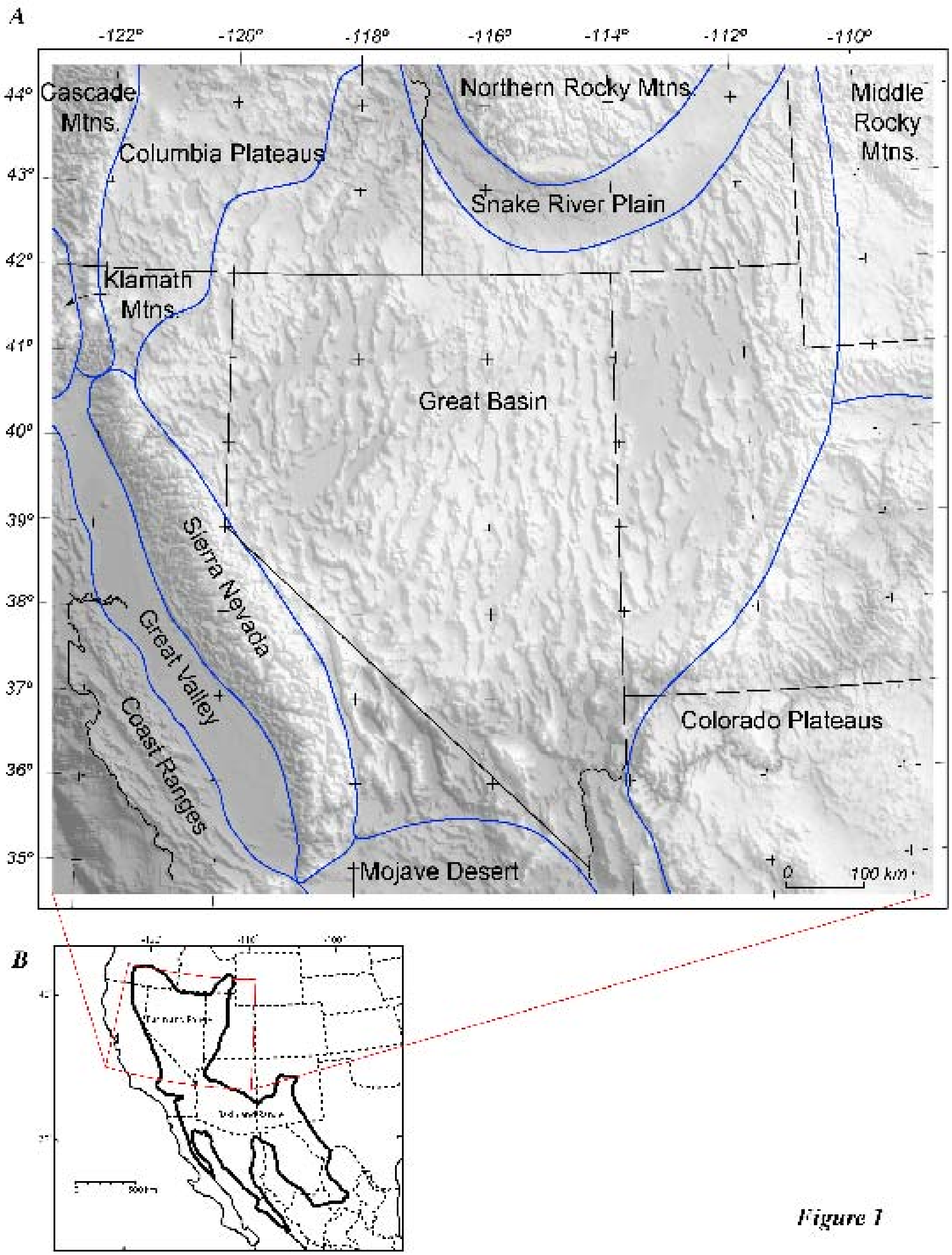
A
-122°
-120°
-118°
-116°
-114°
-112°
-110°
44°
43°
42°
41°
40°
39°
38°
37°
36°
35°
Cascade Mtns.
Columbia Plateaus
Northern Rocky Mtns.
Middle Rocky Mtns.
Snake River Plain
Klamath Mtns.
Great Basin
Sierra Nevada
Great Valley
Coast Ranges
Colorado Plateaus
Mojave Desert
0 100 km
B

Figure 1

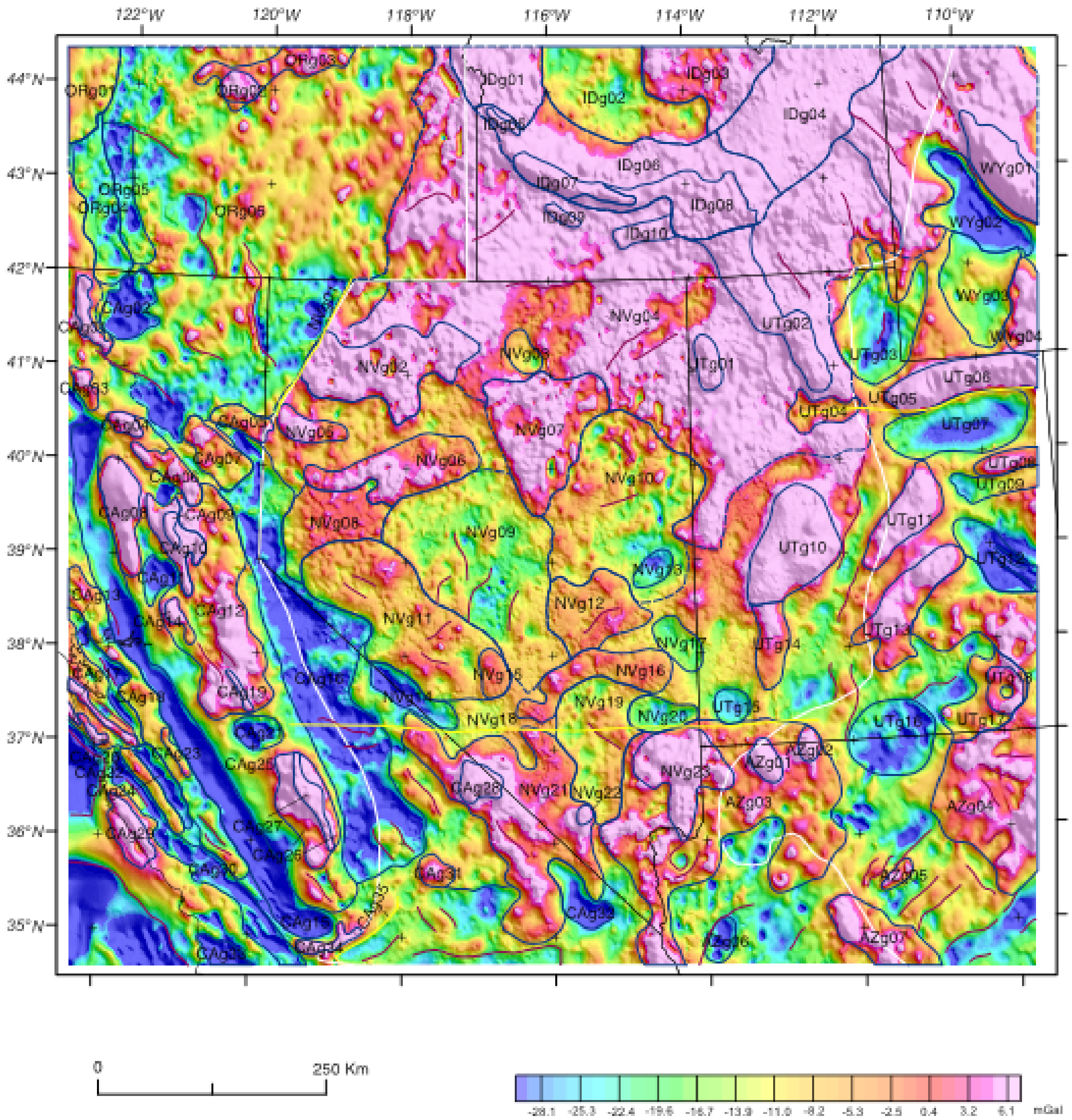

Figure 2. Basement gravity terrane map of the Great Basin. Blue lines circumscribe labeled polygonal features described in Table 1; yellow lines indicate labeled linear features described in Table 1; red lines indicate undescribed linear trends.

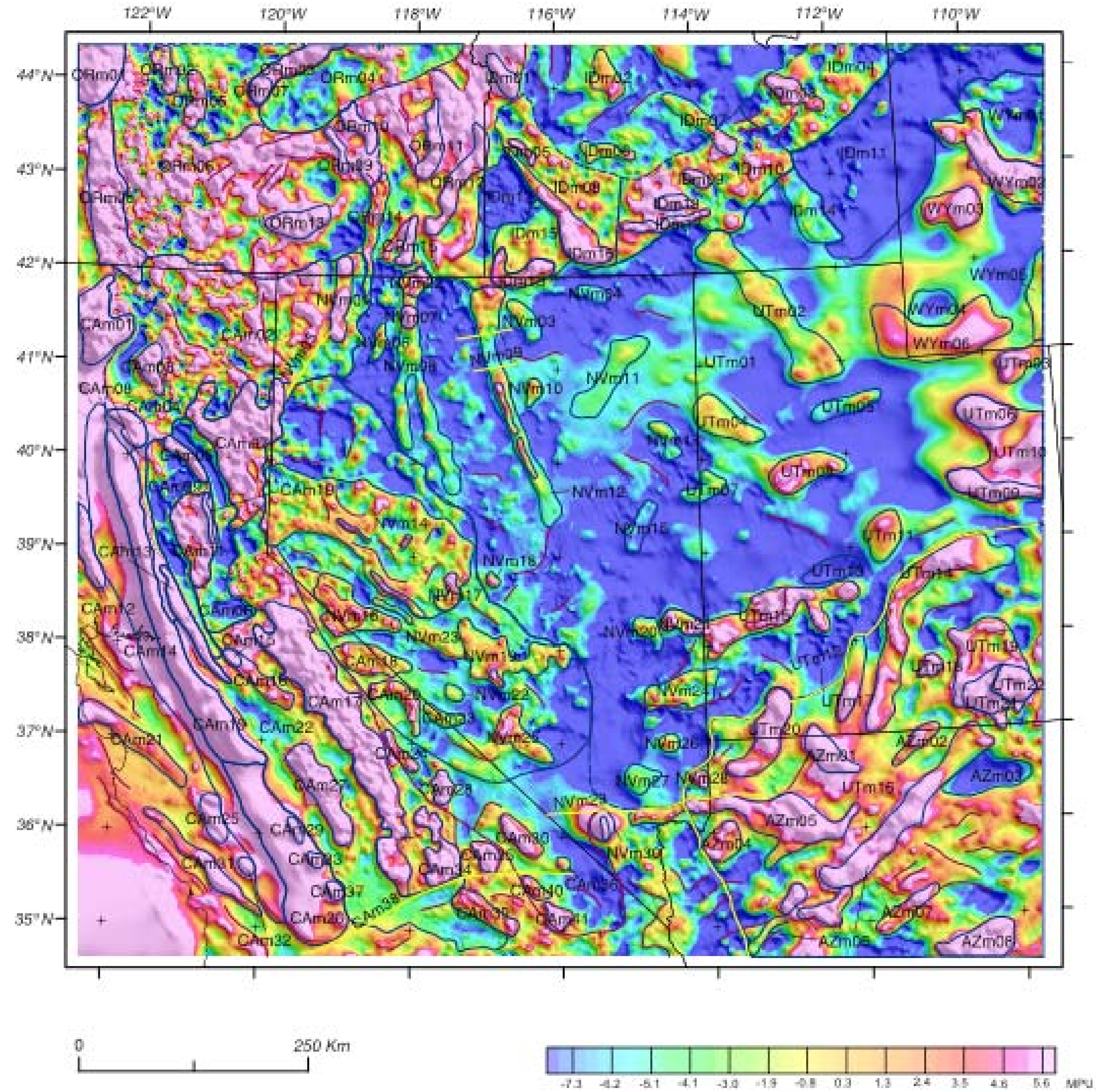

Figure 3. Magnetic potential (pseudogravity) terrane map of the Great Basin. Blue lines circumscribe labeled polygonal features described in Table 1; yellow lines show labeled linear features described in Table 1; red lines show undescribed linear trends.

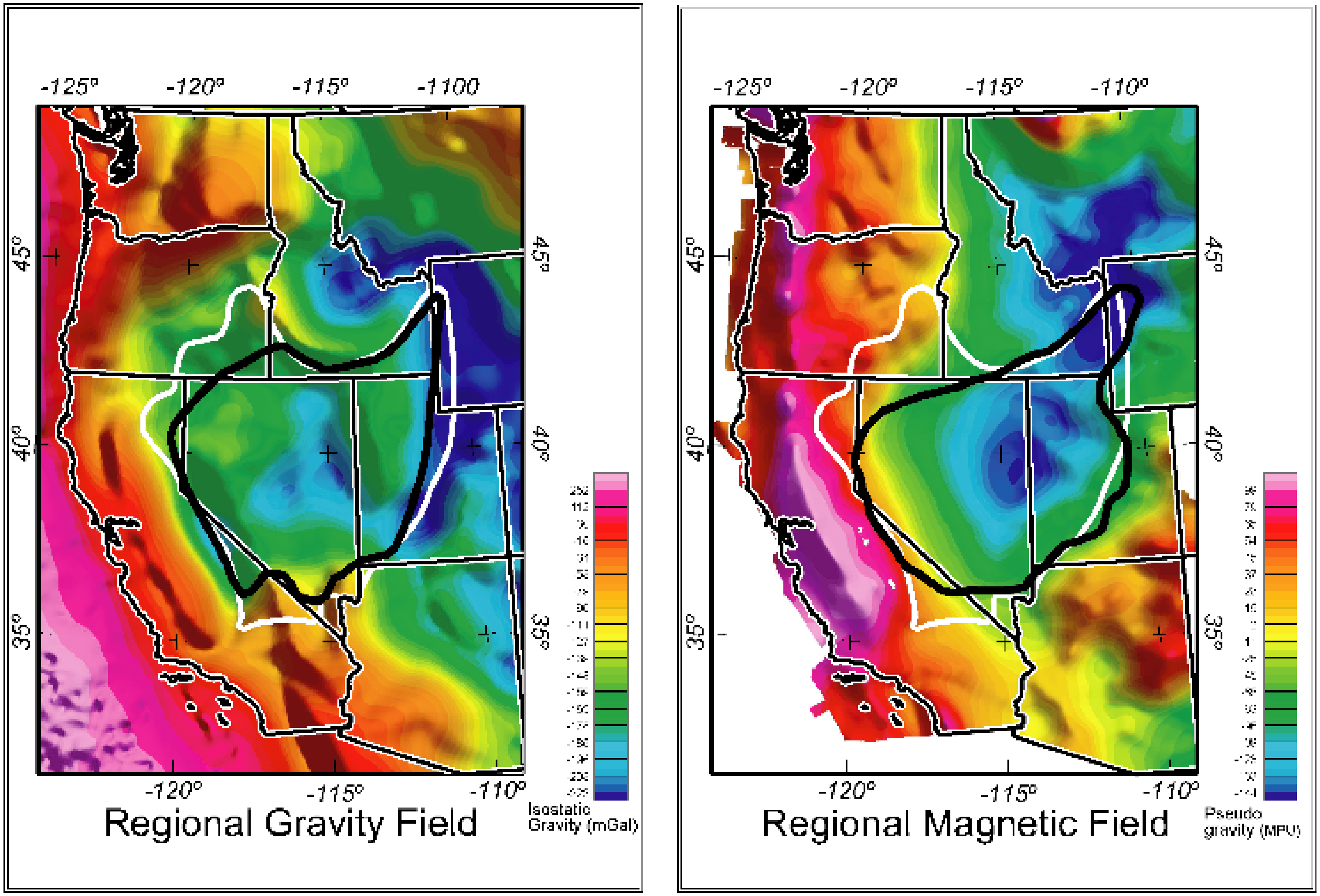

Figure 4. Regional isostatic gravity and pseudogravity field maps of the Great Basin.